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How did that individual make that perceptual decision?

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Title of BBS Target. Suboptimality in Perceptual Decision Making

***Title** of Comment*

How did that individual make that perceptual decision?

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Abstract of Comment

Suboptimality of decision making needs no explanation. High level accounts of suboptimality in diverse tasks cannot add up to a mechanistic theory of perceptual decision making. Mental processes operate on the contents of information brought by the experimenter and the participant to the task, not on the amount of information in the stimuli without regard to physical and social context.

Main Text of Comment

Belief in Bayesian optimality is an example of recurring efforts to escape from the study of basic mechanisms into a world of ideals. Reality takes its revenge as more and more departures from ideal are found and attempts to explain them are refuted or forced into extra detail, as Rahnev and Denison (R&D) show.

Departures from optimality do not need explaining nor can they illuminate mechanisms of perceptual performance. The Bayesian programme fails to reckon with Claude Shannon's insistence that the quantity of information tells us nothing about what the information contains (Shannon & Weaver, 1949). Success or failure at meeting a criterion of optimal use of the amount of information in experimenter's stimuli is irrelevant to what is actually going on in making a perceptual decision. First, any experiment is rich in information of which optimality calculations take no account. Crucial contextual information is explicit as physical arrangements and social signals such as verbal instructions, and implicit in the cultural and material memory that the individual participant brings to each response. Second, the contextual information contents can make some of the content of the experimenter's stimuli dispensable for the perceptual decision. Hence, calculations that do not take context into account can yield an illusory suboptimality. In fact, a substantial number of participants use the whole of the information that each processes from the present and past (e.g., Booth, Sharpe, Freeman & Conner, 2011; Booth, Freeman, Konle, Wainright & Sharpe, 2011).

R&D identify individuality as one source of suboptimality. Far more than that, disregard of individuality prevents mechanistic understanding. Every perceptual decision is determined by an individual's use of information contained in the cultural and material environment of the test. This causal mediation is the transient structure in discrimination-scaled distances between the individual's present and past output/input values (Booth & Freeman, 1993; Booth, Sharpe, Freeman & Conner, 2011). The processed information content varies across individuals and circumstances, and even between particular occasions of the same situation in the same person. Therefore, raw data from individuals should never be averaged before testing a mechanistic hypothesis (Booth & Freeman, 1993; Conner, Haddon, Pickering & Booth, 1988; Booth, 2017), as is now becoming more widely acknowledged (e.g., Luce,

2013). The standard observer models sought by R&D also neglect the idiosyncrasies of information content in the actual mechanisms of perceptual decision making.

Many of results cited by R&D indicate that physical stimuli and context provided by the investigators interacts with social context brought by the participant. One of the paradigms reviewed by R&D is psychophysical judgment. In the usual design, the experimenter uses one of a pair of stimuli as a standard of comparison with the other stimulus which is varied. In fact, each stimulus presentation, whether test or standard, is compared with memory of previous stimuli. The comparative decision is determined by the difference in distances of test and standard from memory of previous exposures in a similar context (e.g., Booth & Freeman, 1993; Stewart, Brown & Chater, 2005). The standard stimulus is at best redundant and may even be a source of range-frequency bias (Poulton, 1988; cp., Conner, Land & Booth, 1987, and Booth, 2016).

In other words, the experimenter's standard is part of the physical context for the test stimulus on which the perceptual decision is supposedly made. Far from the memory of the first stimulus decaying, as R&D cite, long term memory is updated at each presentation. That is how pre-treatment with a high incidence of positive stimuli reduces a bias to making negative responses, also cited by R&D. Accurate diagnosis of the causal structure of a session of perceptual decisions depends on personal tailoring of stimulus levels to be balanced around the familiar level within the range of Weber fraction constancy (Conner, Haddon, Pickering & Booth, 1988; Booth, Freeman, Konle et al., 2011; Booth, Higgs, Schneider et al., 2010).

R&D review a number of the paradigms showing effects of social context, disguised as personality score. Personality inventories are designed to obscure differences in behaviour between situations to create a stable trait, but they vary with state to unknown extents. To permit mechanistic analysis, each relevant social signal has to be presented at two or more levels, unconfounded with other signals within a session. For example, anxiety about being a lying witness in a detection task might be manipulated by the experimenter indicating that some stimuli test for absence of the signal.

Confidence ratings merely express optimistic behaviour or other habits, rather than giving introspective access to mechanisms of perception. Whether the causation is conscious or

unconscious, the only access is through output-input relationships placed on a universal scale of discrimination between present and past.

R&W discuss the variations in trade off between speed and accuracy in reaction times induced by direct instructions or time limits on massed tests, without considering these designs as social pressures. If stimuli provided more scope for using past experience, then the mechanisms of interaction with social context could be investigated. For example, conventional demands for a fast decision or a correct answer could be presented at different levels.

Similarly, deficiencies in signal detection cited by R&D could be reduced by more ecological validity of the random background provided for the test signal. If a familiar enough context were provided throughout, the variance of the response distribution would less likely be higher in the presence of the signal. Furthermore, the line of investigation could be relevant to theoretical and practical issues in such contexts (Booth, 2015).

R&D review evidence that improper perceptual criteria and supposed misweightings in cue combinations account for suboptimality. If the experiments were designed to be analogues of familiar real life scenarios, personally relevant content of the cues could be tested as mechanisms to explain performance.

Finally, it should be noted that effect of unidentified contextual factors can be measured from the individual's causal structure of discrimination scaled content in a session of tests. First, the most successful combination of known output/input relationships may account for substantially less than the total variance in the perceptual response. Second, the discrimination distances between present and past of observed features of the situation may not interpolate through the zero from the past. The eccentricity measures the contextual defect in discrimination units or response quantity (Booth et al., 2011).

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